PRE-PERMIAN STRUCTURE AND PROSPECTIVITY AT GIDGEALPA, SOUTH AUSTRALIA

by

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ABSTRACT

The pre-Permian sediments that underlie the gas and oil productive Cooper and Eromanga Basins at Gidgealpa are part of the Cambro-Ordovician Warburton Basin sequence. This thesis integrates detailed seismic mapping of the pre-Permian structure at Gidgealpa, with other geological elements of petroleum prospectivity including oil and gas shows, source rocks, source maturity, reservoir development, seals and migration pathways.

The tectonic style of the pre-Permian structuring appears, from well and seismic evidence, to be the product of a leading imbricate fan thrust system. Past workers have described a repeat section within the Gidgealpa 1 well based on discordant trilobite fauna and this thesis presents detailed evidence for the occurrence of repeated sedimentary units in two additional wells. The results of two-dimensional thrust ramp modelling of the pre-Permian are also used to support a thrust origin for the structure seen on seismic.

Geochemical analyses of the pre-Permian source rocks, show they are late mature for oil generation and have little remaining oil potential. They probably generated some oil before deposition of the Cooper Basin Sequence, as evidenced from the biodegraded nature of some pre-Permian oil shows. Formation water analyses are used to prove hydrological communication between the Cooper and pre-Permian sediments. Such linkage should assist hydrocarbons to migrate from the

Cooper Basin, but it also increases the risk of top seal to sub-unconformity traps. Vuggy fractured dolomites have demonstrated good porosity and permeability wherever encountered at Gidgealpa and are the main pre-Permian reservoir target. The vugs appear to be controlled by the original wackestone texture in contrast to the fracturing which is tectonically controlled and a product of the thrust system. Potential karst porosity was recognised from wireline logs and is also a pre-Permian reservoir target.

Three petroleum exploration plays within the pre-Permian emerged; two with the petroleum charge coming from the overlying Cooper Basin and the third deriving its charge from within the pre-Permian itself. Reservoirs for the first two plays are either karst limestone "buried hills" or vuggy fractured dolomite sub-unconformity traps. The third playtype involves a vuggy fractured dolomite reservoir and a thrust fault imbricate trap deep within the pre-Permian.

Two recent wells were targeted at each of the Cooper Basin sourced, pre-Permian plays. The results and implications of these two wells are discussed.